CHAPTER 3

TRUCK FLEET AND OPERATIONS

INTRODUCTION

The Nation's truck fleet characteristics and operations are highly varied as trucking evolves within a dynamic environment that includes multi jurisdictional TS&W regulations, safety regulations, freight characteristics, shipper and customer needs, economic forces, international trade, and truck and trailer manufacturer innovation. The truck fleet and use are described in the following sections: (1) trucking industry structure, (2) equipment characteristics, (3) relationship between TS&W policy and truck characteristics, and (4) trucking operations (truck flows, commodity case studies, cross-border trucking, and container use).

TRUCKING INDUSTRY STRUCTURE

As trucking serves many different markets, it has become highly segmented in order to respond efficiently to these markets. Broadly, the industry may be divided into either private or for-hire carriers. In the for-hire sector, two types of services are provided: truckload (TL) and less-than-truckload (LTL). Additionally, TL and LTL services can be segmented into either short haul or long haul.

PRIVATE VERSUS FOR-HIRE CARRIERS

Many private businesses have internalized all aspects of their logistics including owning and operating their own truck fleet. Common examples of private carriers include grocery stores, retail chains, and food processing companies. Information on the operations of private carriers is limited, partially because these carriers traditionally have been less subject to government reporting requirements. Table III-1 indicates that private carrier operations constitute a large share of trucking in the Nation.

Table III-1
Private Carrier Profile - 1993

TONNAGE AND VALUE OF SHIPMENTS

- Private carriers handled approximately 3.56 billion tons of the total 6.5 billion tons (55 percent) handled by the trucking industry.
- The average length of haul for private carriers is 51 miles, resulting in 240 billion ton-miles handled.
- The value of freight handled by private carriers was $1.8 trillion, $1.0 trillion lower than the for-hire carriers.

REVENUE

- Private carriers captured approximately 54 percent ($178 billion) of total truck revenue in the Nation.
- The $178 billion in revenue was split between intercity and local freight movements, approximately $90/$88 billion, respectively.
- Overall, private carriers captured 70 percent of local revenues.

Source: 1993 CFS Database

For-hire carriers transport goods for others as their primary business. This segment of the trucking industry includes a large and growing number of single vehicle owner-operators. Information on share of freight handled by the for-hire segment in 1993 is provided in Table III-2.

Table III-2
For Hire Carrier Profile - 1993

TONNAGE AND VALUE OF SHIPMENTS

- The for-hire carriers' share of total truck freight movements (6.5 billion tons) was 2.9 billion tons (45 percent).
- The average length of haul of for-hire carriers is 470 miles.
- The value of shipments for for-hire carriers equaled $2.8 trillion.

REVENUE

- For-hire carriers captured approximately 56 percent of total intercity market revenues.

TL VERSUS LTL OPERATIONS

The TL carriers generally pick up a load in a truck or truck combination at the shipper's dock and transport it directly to the consignee in the same vehicle. The TL operations are categorized according to the type of freight handled, either general or specialized. General freight is transported in enclosed van trailers; specialized freight is transported by specialized equipment,

such as refrigerated van trailers, automobile transporters, tank trailers, dump trucks, and hopper-bottom grain trailers. Many TL carriers depend on the services of owner-operators for equipment and drivers.

While there were more specialized carriers than general freight carriers in 1993, the revenue generated from general freight was slightly higher than that generated by specialized freight carriers ($11.7 billion versus $11.4 billion). In the late 1980s, a small number of "megacarriers" emerged from within the large TL carriers. These megacarriers now dominate the general freight segment of TL operations. Additionally, since the early 1990s, some of the general freight TL carriers have become major intermodal carriers with large domestic container fleets.

The LTL carriers specialize in transporting small shipments of freight, generally in units of between 250 pounds and 12,000 pounds. An LTL shipment is comprised of general freight from several shippers and has many different destinations. An example of an LTL carrier is a package delivery service provider. In most instances, LTL carriers are constrained more by cubic capacity than weight limitations. One exception is an LTL carrier that transports international containers from a port to a break-bulk terminal. Often these potentially overweight containers are moved to a terminal under special permit, emptied, and their cargo reloaded for line-haul movements at 80,000 pounds or less. To reduce line-haul miles and handling of freight, LTL carriers use strategically located terminals and operate truck combinations between them on regularly scheduled line-haul routes.

SHORT-HAUL VERSUS LONG-HAUL OPERATIONS

Short-haul operations are defined for this Study as freight movements of 200 miles or less from origin to destination. Consequently, the majority of truck operations on a nationwide basis are considered short haul, being regional or local in nature. Single-unit trucks operate almost exclusively within their home State (intrastate).

Typically, trucks operating in local, short-haul operations have lower annual VMT than those in long-haul, which varies greatly according to type of truck configuration. In general, single-unit trucks have average VMT much lower than truck combinations. For example, average VMT for 2-axle single-unit trucks is 11,000 miles, or about 30 miles per day. The 3- and 4-axle single-unit trucks are slightly higher at about 40 miles and 60 miles per day, respectively.

Annual average VMT for long-haul operators is substantially higher. For example, tractor- semitrailer combinations average between 100 miles and 200 miles per day. The STAA double-trailer combinations average 220 miles per day, or about 80,000 miles per year.

EQUIPMENT CHARACTERISTICS

The most general distinction among truck configurations is whether they are single-unit trucks whose cargo-carrying units are mounted on the same chassis as the engine, or whether they are combination vehicles that have separate cargo-carrying trailers or semitrailers that are pulled by a truck or truck-tractor. Nationally, the distribution of the trucking fleet by configuration is approximately as follows:

Single-unit trucks - 68 percent;
Truck-trailer combinations - 4 percent;
Tractor-semitrailer combinations (primarily 5-axle combinations) - 26 percent;
Double-trailer combinations - 2 percent; and
Triple-trailer combinations - less than one-tenth of 1 percent.

The distribution of large truck configurations, combinations with 5 or more axles, varies among States and regions. For example, in California 18 percent of the truck fleet are truck-trailer combinations and 39 percent are STAA twin-trailer combinations; in Florida, only 2 percent of the truck fleet are truck-trailer combinations and 1.6 percent are double-trailer combinations.[1] Figure III-1 presents the different types of configurations in the national truck fleet.

The U.S. trailer fleet increased significantly following passage of the STAA of 1982. The number of trucks and truck-tractors increased only marginally (see Figure III-2). In 1994, the total commercial truck fleet consisted of approximately 1.3 million truck-tractors and 4.1 million trailers, including semitrailers. The increase in the number of trailers was commensurate with an increase in the number of STAA doubles and LCVs (that is, double- and triple-trailer combinations).

SINGLE-UNIT TRUCKS

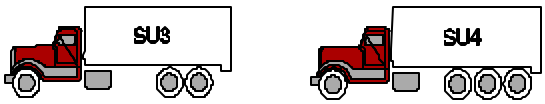
The most common single-unit trucks in the commercial fleet with three or more axles are dump trucks, transit mixers, tank trucks, and trash trucks. These vehicles are designed to provide specialized services and are commonly referred to as specialized hauling vehicles (SHVs). They have from 2- and 4-axles. The SHVs represent approximately 46 percent of the single-unit trucks operating in the United States with 3 or more axles. They are typically used in local and intrastate, short-haul operations. The most common commodities that they haul are construction materials, gravel, ready-mix cement, grain, milk, petroleum products, and garbage or waste.

The total number of commercial single-unit trucks (10,000 pounds or more) remained constant at approximately 2.75 million between 1982 and 1994. However, the number of 2-axle single-unit trucks decreased over this period by about 14 percent. During that same period of time, the number of 4-axle single-unit trucks more than doubled to approximately 84,000 due to the substitution of 3-axle trash, dump and concrete trucks with 4-axle units.

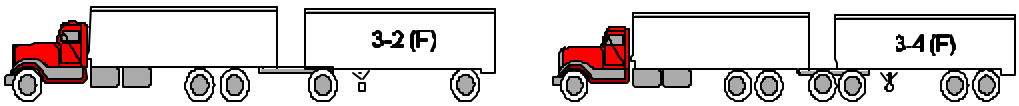
[1] 1992 TIUS Database.

Figure III-1
Illustrative Truck Configurations of U.S. Fleet

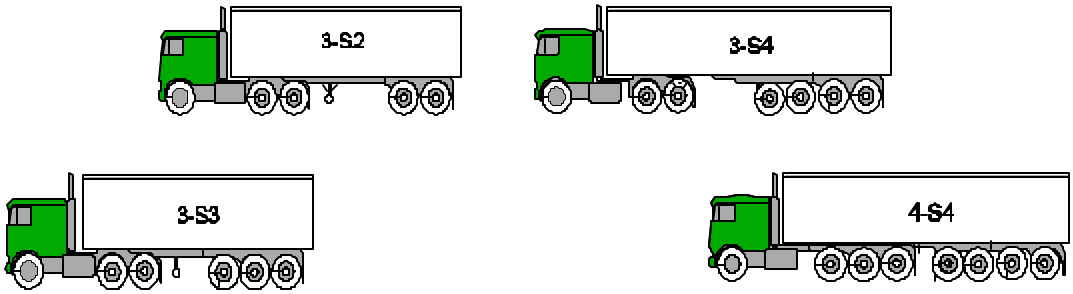
Single-Unit Trucks



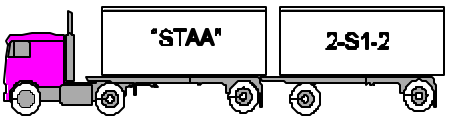
Truck-Trailer Combinations



Tractor-Semitrailer Combinations

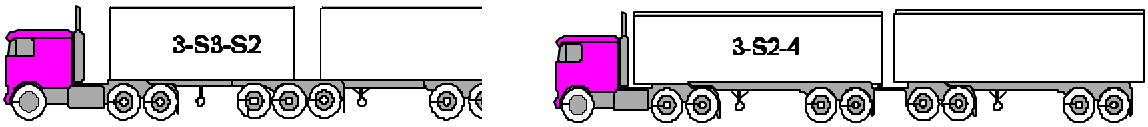


STAA Double-Trailer Combination



LCVs

Double-Trailer Combinations



Triple-Trailer Combination

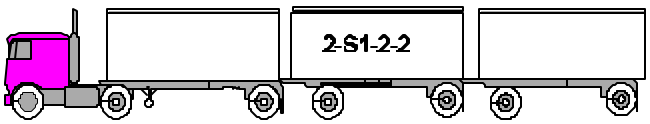
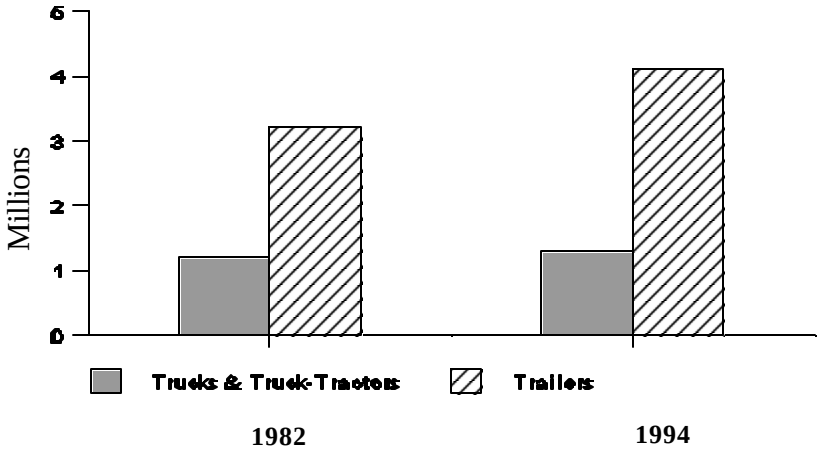


Figure III-2
Fleet Size And Growth: 1982-1994



TRUCK-TRAILER AND TRACTOR-SEMITRAILER COMBINATIONS

Combination vehicles in the national truck fleet consist of a towing unit, either a truck or tractor, and one or more trailers or semitrailers. Truck-trailer combinations account for approximately 14 percent of all combination vehicles.

TRACTOR-SEMITRAILERS

Tractor-semitrailer combinations account for more than 82 percent of all combination trucks on U.S. highways. The number of semitrailer combinations has increased an average of 2.5 percent per year between 1982 and 1994. Increases in long-haul operations following the STAA of 1982, and the market for sleeper cab tractors, resulted in a shift away from 2-axle tractors, such as the cab-over models of the early 1980s, toward longer wheelbase 3- and 4-axle tractors.

MULTITRAILER

The more typical multitrailer combinations operating in the United States are: STAA doubles (twin 28-foot trailers), RMDs, turnpike doubles (TPDs), and triples. The LCV are the RMD, TPD, and triple-trailer combinations. LCVs represent a very small number in relation to the total truck combination fleet, approximately 20,000 in 1994 or 0.5 percent. Like single-unit trucks and other combinations, multitrailer combinations are used to haul a variety of commodities, and their trailers are specialized for the commodities being carried.

STAA DOUBLES

The STAA of 1982 provided for the unrestricted use of two-trailer combinations (two 28-foot to 28.5-foot trailers) on the NN. The NN consists of the Interstate System and routes designated by the FHWA in consultation with the States. Prior to 1982 the operation of double trailers of any length was primarily limited to States west of the Mississippi River and turnpikes in a few eastern States.

Since 1982, growth in the use of STAA doubles in relation to the size of the total truck fleet has been relatively small nationwide, except for those States in the East where they had been previously prohibited. Nationwide, STAA doubles represent approximately 2.5 percent of all truck combinations. Generally, STAA doubles are most important to the LTL industry.

LCVs

Figure III-3 illustrates the common types of LCVs: RMD, TPD, and triples. The RMDs consist of a truck-tractor and one long front trailer, ranging in length from 40 feet to 48 feet, towing a shorter 20-foot to 28-foot trailer. The RMD combinations are currently allowed to operate on turnpikes in 6 States and on other routes in 17 States. (Some States like Iowa and Missouri limit the access of LCVs to specific terminals within the State).

The TPD combinations consist of a truck-tractor towing two long trailers of equal length, typically two 48-foot or 53-foot trailers. The TPD combination is allowed in all but three (Oregon, Washington, and Wyoming) of the States in which RMDs are allowed to operate. However, the allowable weights and the extent of highway networks upon which these vehicles may operate vary among the States.

A triple-trailer combination consists of a tractor and three trailers in tow -- typically three 28-foot to 28.5-foot trailers. Triple-trailer combinations are allowed to operate on limited highway networks in 15 States under permit with restrictions. Triple-trailer combinations have been operating in Idaho, Nevada, Oregon, and Kansas since the 1960s.

Figure III-3 provides a list of the States where LCVs are allowed to operate, by configuration. Also indicated is the first year of operation

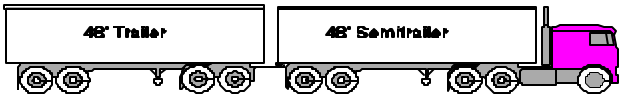
RELATIONSHIP BETWEEN SIZE AND WEIGHT POLICY AND TRUCK CHARACTERISTICS

Federal and State TS&W regulations define the weight and dimension envelopes into which loaded trucks must fit. Other influencing factors are the freight hauled and associated logistical considerations (shipment size, packaging, fragility, temperature control, origin-destination patterns, delivery time requirements); infrastructure considerations (terminals and route options between origin-destination pairs); truck economic considerations (replacement cycles, resale

Figure III-3
LCVS

RMD

Turnpike Double



Triple-Trailer

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markets, fuel economy, driver flexibility); truck operating strategies and company structures; special permitting policies and practices; regulation enforcement; and intermodal considerations.

Sometimes a truck is operated within only one TS&W regulatory regime; typically however, the regime is a composite of various limits established by Federal and State regulations. Additionally, for trucks operating across an international border with Canada or Mexico, Canadian provincial law or Mexican federal law applies. A trucker confronted with multiple TS&W regimes must either select a "least common denominator" vehicle and operating strategy, or a strategy that can be modified en route (for example, removing a trailer, reducing the load, moving an axle or axles).

Interestingly, beginning in the late 1980s an industry trend began to emerge; the mean average loaded weights (tare weights plus payload weights) were decreasing, while the tare weights of trucks increased. Commodities transported, such as electronic equipment and more highly processed goods, are becoming lighter. Table III-4 provides information on average payload and loaded weights for the five major truck and combination body types operating nationwide in 1994. Note that: (1) on average, none of these combinations uses the maximum weight allowed, and (2) 5-axle tractor-semitrailer combinations with specialized body types (dump, tank, grain) for hauling bulk commodities use about 93 percent of the allowed 80,000 pounds GVW.

Table III-3
Permitted LCVs by State and Configuration

State	Turnpike Doubles		
	Triples		RMDs
Alaska	Not Permitted	1984	1984
Arizona	1976	1976	1976
Colorado	1983	1983	1983
Idaho	1968	1968	1968
Montana	1987	1972	1968
Nebraska	1984	1984	1984
Nevada	1969	1969	1969
North Dakota	1983	1983	1983
Oklahoma	1987	1986	1986
Oregon	1967	Not Permitted	1982
South Dakota	1988	1984	1981
Utah	1975	1974	1974
Washington	Not Permitted	Not Permitted	1983
Wyoming	Not Permitted	Not Permitted	1983
State Turnpike Authority	**Turnpike Doubles**		
	Triples		**RMDs**
Florida	Not Permitted	1968	1968
Indiana	1986	1956	1956
Kansas	1960	1960	1960
Massachusetts	Not Permitted	1959	1959
New York	Not Permitted	1959	1959
Ohio	1990	1960	1960

Source: U.S. GAO, *Longer Combination Trucks* (Washington, D.C., 1994).

Table III-4
Average Payload and Loaded Weight of Common Truck Types (Pounds)

Body Type	5-Axle Truck-Trailer		5-Axle Tractor-Semitrailer		STAA Double	
	Payload	Loaded	Payload	Loaded	Payload	Loaded
Platform/flatbed	30,715	56,900	36,780	65,350	45,330	64,470
Van	34,890	60,340	30,555	61,550	33,935	65,100
Grain Body	48,970	63,340	48,030	74,570	56,380	80,140
Dump Truck	34,760	59,460	42,580	72,160	*	*
Tank Body	47,980	72,390	46,410	74,490	*	*

* Indicates very small sample size.

GVW LIMITS

Most trucks and combinations operate at or below the GVW limits, as they do not reach their weight limit because the available space in the truck becomes filled first, that is, it "cubes out." Tank trucks and trailers operate at average load levels that reach their maximum weight limit and "weigh-out" over 80 percent of the time; this occurs less than 20 percent of the time for enclosed van trailer combinations. Enclosed van trailers, in many instances, are used to transport commodities that have low density.

The 1975 FBF mandate led to a variety of vehicle configurations and characteristics not initially envisioned. These new configurations are typically directed at increasing the potential payload. Examples of such "bridge formula" trucks are: (1) 4-axle tractors with a lift axle; (2) very long "tongues" on truck-trailer and double-trailer combinations (to increase axle spacing, and therefore, allow a higher gross weight limit); and (3) split tandem axles, now a common feature of 5-axle tractor-semitrailers carrying heavy commodities.

AXLE WEIGHT LIMITS

One or both of the Federal axle limits (20,000 pounds for a single axle and 34,000 pounds for tandem axles) are surpassed through the exercise of grandfather rights for Interstate highways in 12 States, and permit policies in others. Weight limits for other axle groups are determined through the application of the FBF or State regulation in some cases.

Current Federal axle weight limits were established to minimize pavement damage and the FBF, a formula specifying a maximum gross weight given a vehicles wheelbase and the number of axles it has. The Federal provision also has a maximum GVW of 80,000 pounds. Consequently, various innovative arrangements of axles and tires have evolved to increase load capacity within the GVW limit and not exceed axle limits. Three of these innovative arrangements are super single tires, split tandem axles, and lift axles (within 3- and 4-axle groups -- tridems and quadrems).

The increasing use of wide-base super single tires instead of dual tires in the United States is an innovation that originated in Europe. Federal law and most State laws do not prohibit the use of wide-base single tires. Benefits to industry include reduced energy use, tare weights, and truck operating costs. As with tire pressure and tire loads, there are conflicting views concerning the public benefits and costs and whether the use of wide-base tires should be regulated.

AXLE CONFIGURATIONS

Axle configurations frequently observed on single-unit trucks, especially SHVs, include tridem axles, lift axles, split tandem axles, and quadrem axles. Use of these configurations has evolved over the last two decades as industry adapted to Federal and State weight policies.

TRIDEM AXLES

Semitrailer combinations with a tridem axle on the semitrailer are operating in all States, as are single-unit trucks with tridem axles. Tridem-axle semitrailers are used in about 5 percent of the truck combinations operating nationwide and are most common in the Northeast region. On tractor-semitrailers, tridem axles offer the advantage of higher gross loads (especially in those States not limited by the 80,000-pound Federal weight limit). This is particularly important for movement of commodities such as building materials and heavy machinery on tractor-semitrailer combinations.

LIFT AXLES

Throughout the country, lift axles are routinely used on single-unit trucks, such as dump trucks and cement mixers, as well as on semitrailers operating where GVWs over 80,000 pounds are permitted. Lift axles are used on over 70 percent of all 4-axle, single-unit trucks. In several States, 5-, 6-, and 7-axle single-unit trucks with two to four lift axles are used. Federal TS&W laws, as well as most State laws, do not address the use of lift axles.

Generally, a truck operates with the lift axle down when loaded to increase its weight limit, and up when empty to improve vehicle maneuverability and handling. On the other hand, lift axles allow the driver to raise the axle of a loaded truck during operation on the highway, which redistributes the loaded weight over fewer axles.

SPLIT TANDEM AXLES

A split tandem axle is created by increasing the spacing between the 2-axles in a tandem axle group from a typical standard of approximately 4 feet to 8 feet, 9 feet, or 10 feet. Split tandem axles are an increasingly common feature of trucking throughout the United States. Their operational advantages are: (1) they increase GVW within the allowable limit, and (2) they provide increased flexibility in load distribution. By increasing the spacing, the split tandem, rather than being considered a tandem axle with an axle weight limit of 34,000 pounds, is considered as two single axles with a total allowable weight governed by the FBF. The combined weights allowed on a split tandem axle are 38,000 pounds for a spread of more than 8 feet, 39,000 pounds for 9 feet, and 40,000 pounds for 10 feet or more.

DIMENSIONAL LIMITS

SEMITRAILER LENGTH

Federal law concerning semitrailer length (48 feet) and trailer length for standard STAA doubles (28 feet) is a facilitating law, specifying the minimum lengths that States must allow on the NN for large trucks. As a result, semitrailer lengths throughout the country are largely controlled by State laws specifying maximum semitrailer lengths and, sometimes, tractor- semitrailer combination lengths.

Van trailers are designed to maximize payload within the length limits of the States in which the vehicle will be operating. For example, van trailers for hauling grain are often designed with drop-bottoms to increase cubic capacity without exceeding State height limits. On the other hand, flatbed trailers often do not need the available length or width. In certain States semitrailer lengths and operating properties are also influenced by kingpin requirements. Such laws set a specified distance from the trailer kingpin connection to a specified axle or the center of the semitrailer axle group.

Semitrailers have undergone major changes in the last 30 years in response to changes in Federal and State regulations, such as the shift from the industry standard 45-foot semitrailers to current use of 53-foot semitrailers. The historic trend has been incremental growth in the length of semitrailers, with each new length taking about 10 years to 12 years to become the new standard. For example, the 45-foot semitrailers introduced in 1970 were the industry standard for van trailers until the 1980s, when the 48-foot semitrailer became the standard. The new market share for the 53-foot semitrailer in 1994 was 30 percent; This semitrailer offers an 18 percent increase in cubic capacity over the 45-foot semitrailer.

The distribution of 53-foot semitrailers by trailer body type is: (1) 30 percent to 40 percent of all types of van trailers; (2) 15 percent to 20 percent of the flatbed fleet; and (3) less than 10 percent of specialized truck body types. Currently, semitrailers longer than 53 feet are permitted to operate in 10 States (on most State NN facilities) -- Alabama, Arkansas, Arizona (Interstate only), Colorado, Kansas, Louisiana, New Mexico, Oklahoma, Texas, and Wyoming. The extent of their use is unknown, although it is believed to be relatively small at the present time.

WIDTH

The STAA of 1982 provided for the free movement of 102-inch wide equipment on the NN. Although the law provided for uniformity on Interstate and NN highways, several States have a 96-inch-width limit for commercial vehicles on non-NN routes. As a consequence, 96-inch wide equipment remains commonplace, especially for trucks that meet the maximum weight limits before using the allowed cubic space.

HEIGHT

Height limits have been established over the years to ensure clearance of vehicles under rail or highway overpasses. The clearance standard for bridges constructed over the Interstate System is a minimum of 14 feet in urban areas, where space is limited, and 16 feet in rural areas. Some State constructed turnpikes built prior to 1956 do not meet the Federal standard, and the clearances must be posted. Most Western States limit vehicle and load heights to 14 feet; while the Eastern States, except Maine, limit vehicle and load heights to 13.5 feet.

TRUCKING OPERATIONS

The relative intensity of truck traffic throughout the Nation can be measured by the volume of truck flows on major highways and truck VMT in each State.

TRUCK FLOWS

Truck flows on the NHS are illustrated in Figure III-4. These flows range from fewer than 100 trucks per day on rural corridor highways to over 25,000 trucks per day on Interstate

highways in and around major urban centers. General observations regarding these flows are:

- Truck traffic on the NHS varies widely throughout the country, ranging from an annual average of one or two trucks per hour in each direction to more than 500 trucks per hour.

- Truck volume on most of the NHS in the Western Region is relatively low. Exceptions include major North-South routes in the Interstate Route 5 Coastal Corridor, and major East-West corridors associated with Interstate Route 80, Route 40, Route 10, and Route 20.

- Truck volumes east of the Mississippi on much of the NHS range from modest in the New England States to very high in the mid-Atlantic region.

- Many of the highways in the North-South, mid-continent I-35 Corridor have low to modest truck volumes. The lowest truck volumes in this corridor are at the northern and southern ends, and in the middle of the corridor through Kansas. Dominant trucking activity in the corridor includes East-West trips and travel between most corridor States and the North-Central region of the United States.

TRUCK VMT

Total truck VMT in 1994 was approximately 168 billion, which is distributed among the States as shown in Table III-5. California had the highest truck VMT (16.8 billion), equal to 10 percent of the national truck VMT. Regional distribution of total truck VMT is approximately 25 percent in the North-Central region; 20 percent in each of the South Atlantic, South Gulf, and Western regions; and 15 percent in the Northeast region.

SINGLE-UNIT TRUCKS

Single-unit trucks account for approximately 42 percent of total truck VMT. The 2- and 3-axle trucks account for the majority of the single-unit truck VMT, approximately 85 percent and 12 percent,

respectively. Although the number of 4 or more axle single-unit trucks has more than doubled since 1982, their share of the annual VMT, 3 percent, is an indication that their use is primarily short haul.

SINGLE-TRAILER COMBINATIONS

Tractor-semitrailer combinations are the most common combination operating in the country, accounting for over 25 percent of all registered trucks and 82 percent of all truck combinations. They include combinations of a 2-, 3-, or 4-axle tractor with a semitrailer having 1 or more axles (up to 8 in Michigan). In 1994, tractor-semitrailers accounted for approximately 53 percent of total truck VMT, or 89.6 billion VMT.

Truck-trailer combinations are the second most common combination in the country, accounting for approximately 14 percent of the truck combination fleet. Their use increased significantly since 1982, primarily in the North Central region. With 3.1 billion VMT, however, truck-trailer combinations account for less than 2 percent of total truck VMT. Over 50 percent of this VMT is attributed to the 5-axle combination.

MULTITRAILER COMBINATIONS

STAA Doubles

The VMT for the STAA double (twin 28-foot) in 1994 was approximately 4.5 billion miles per year, or 2.6 percent of all truck VMT. It accounted for 4.5 percent of all truck combinations VMT, and 71 percent of all VMT by double-trailers.

LCVs

The LCVs are permitted in 21 States and include RMD, TPD, and triple-trailer combinations (see Table III-3 for a listing of where these vehicles are permitted to operate). Total VMT for the longer double-trailer combinations was 1.8 billion VMT in 1994, or approximately 1 percent of all truck VMT and less than 2 percent of all combination VMT.

The number of triple-trailer combinations is relatively small compared to the total truck combination fleet. In 1994, total VMT for triple-trailer combinations was 108 million distributed among the 14 States in which they operate. On average each triple combination travels approximately 90,000 miles per year. Total triple-trailer VMT was approximately 0.1 percent of the total VMT for all combinations, with approximately half of the VMT occurring in Oregon and Utah.

Figure III-4
Truck Flows on the NHS

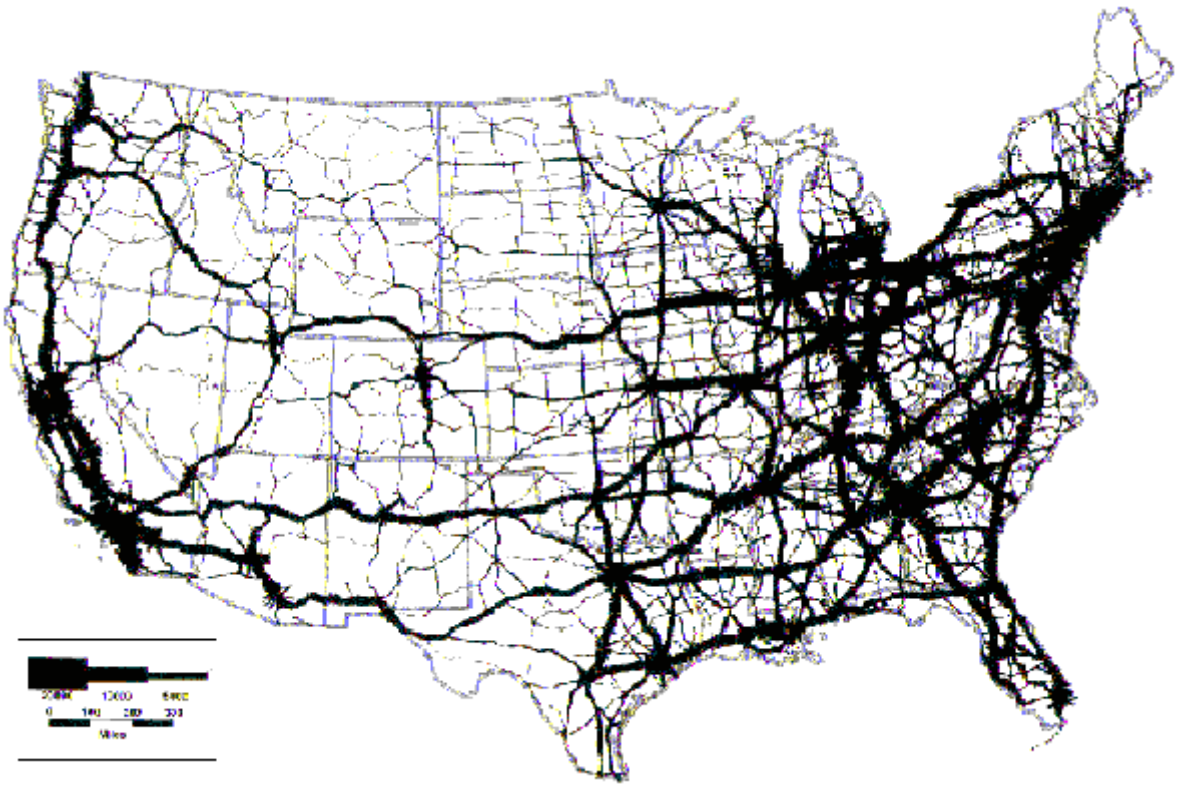


Table III-5
Truck VMT by State: 1994
(Thousands)

State	Total VMT	Total Truck VMT	State	Total VMT	Total Truck VMT
Alabama	48,955,998	3,618,154	Montana	9,116,001	764,175
Alaska	4,149,989	195,239	Nebraska	15,465,999	1,572,777
Arizona	38,773,999	3,932,615	Nevada	13,019,000	1,224,392
Arkansas	24,947,997	3,015,746	New Hampshire	10,501,000	598,353
California	271,942,998	16,769,280	New Jersey	60,465,998	3,584,790
Colorado	33,704,999	2,484,491	New Mexico	20,479,999	1,758,453
Connecticut	27,138,000	1,195,570	New York	112,970,002	5,235,286
Delaware	7,025,000	396,163	North Carolina	71,928,001	8,874,775
Dist of Col	3,448,000	114,106	North Dakota	6,337,999	583,377
Florida	121,989,000	6,282,027	Ohio	98,199,997	7,208,332
Georgia	82,821,999	5,490,345	Oklahoma	36,979,997	3,151,269
Hawaii	7,934,999	279,371	Oregon	29,453,000	2,116,079
Idaho	11,652,000	907,409	Pennsylvania	92,347,001	8,104,688
Illinois	92,316,001	6,200,093	Rhode Island	7,095,000	326,770
Indiana	62,108,001	5,740,501	South Carolina	37,245,001	2,033,429
Iowa	25,736,997	3,004,366	South Dakota	7,630,998	551,802
Kansas	24,678,000	1,714,820	Tennessee	54,524,001	3,699,589
Kentucky	39,822,001	2,894,242	Texas	178,347,999	14,471,141
Louisiana	37,430,000	4,875,763	Utah	18,078,002	1,376,369
Maine	12,469,001	779,987	Vermont	6,152,000	405,991
Maryland	44,164,999	3,291,562	Virginia	67,608,999	4,988,220
Massachusetts	46,989,999	1,723,840	Washington	47,428,000	3,444,500
Michigan	85,182,998	4,551,583	West Virginia	17,112,001	1,569,653
Minnesota	43,317,002	2,444,670	Wisconsin	50,273,000	3,175,214
Mississippi	28,548,000	2,313,672	Wyoming	6,688,998	827,671
Missouri	57,288,000	4,534,102	TOTAL	23,599,983,970	170,396,812

Source: 1997 U.S. DOT, HCA Study (Washington, D.C., 1997)

HIGHWAY NETWORKS FOR MULTITRAILER COMBINATIONS

The highway network for operation of STAA doubles and LCVs is limited when taken as a percentage of the total public road mileage in each State. This is in contrast to total public road mileage of 3,906,544. While STAA doubles are allowed in all States, doubles combinations longer than 28.5 feet are only allowed in 21 States. Indeed, the ISTEA enforced a freeze limiting the use of the longer, heavier double- and triple-trailer combinations to those States in which they were already operating in 1991. The TS&W limits that included in the 1991 grandfather provision are summarized in Table III-6. Of the 21 States allowing longer combination doubles, all but five are west of the Mississippi River. Figures III-5 and III-6 provide maps of the RMD and TPD highway networks.

Table III-6
Operation of Vehicles Subject to the ISTEA Freeze
Maximum Size and Weight Limits

State	Truck Tractor and Two Trailing Units	Truck Tractor and Three Trailing Units	Other
	Length in Feet (‘)/Weight in 1,000 Pounds (K)		
Alaska	95'	110'	83'
Arizona	95' 129K	95' 129K	69' - 98'
Colorado	111' 110K	115.5' 110K	78'
Florida	106' (1)	No	No
Idaho	95' 105.5K	95' 105.5K	78' - 98'
Indiana	106' 127.4K	104.5' 127.4K	58'
Iowa	100' 129K	100' 129K	78'
Kansas	109' 120K	109' 120K	No
Massachusetts	104' 127.4K	No	No
Michigan	58' 164K	No	No
Missouri	110' 120K	109' 120K	No
Montana	93' 137.8K	100' 131.06K	88' - 103'
Nebraska	95' 95K	95' (1)	68'
Nevada	95' 129K	95' 129K	98'
New Mexico	86.4K (2)	No	No
New York	102' 143K	No	No
North Dakota	103' 105.5K	100' 105.5K	103'
Ohio	102' 127.4K	95' 115K	No
Oklahoma	110' 90K	95' 90K	No
Oregon	68' 105.5K	96' 105.5K	70'5"
South Dakota	100' 129K	100' 129K	73' - 78'
Utah	95' 129K	95' 129K	88' - 105'
Washington	68' 105.5K	No	68'
Wyoming	81' 117K	No	78' - 85'

(1) No maximum weight is established as this vehicle combination is not considered an “LCV” per the ISTEA definition. Florida’s combinations not allowed to operate on the Interstate System..

(2) No maximum cargo-carrying length is established for this combination. Because State law limits each trailing unit to not more than 28.5 feet in length, this combination is allowed to operate on all NN routes under the authority of the STAA of 1982, regardless of actual cargo-carrying length. The maximum weight listed is New Mexico’s maximum allowable gross weight on the Interstate System under the grandfather authority of 23 U.S.C. 127.

Source: FHWA Publication Number FHWA-MC-96-03

Figure III-5
Highways Available for Turnpike Doubles

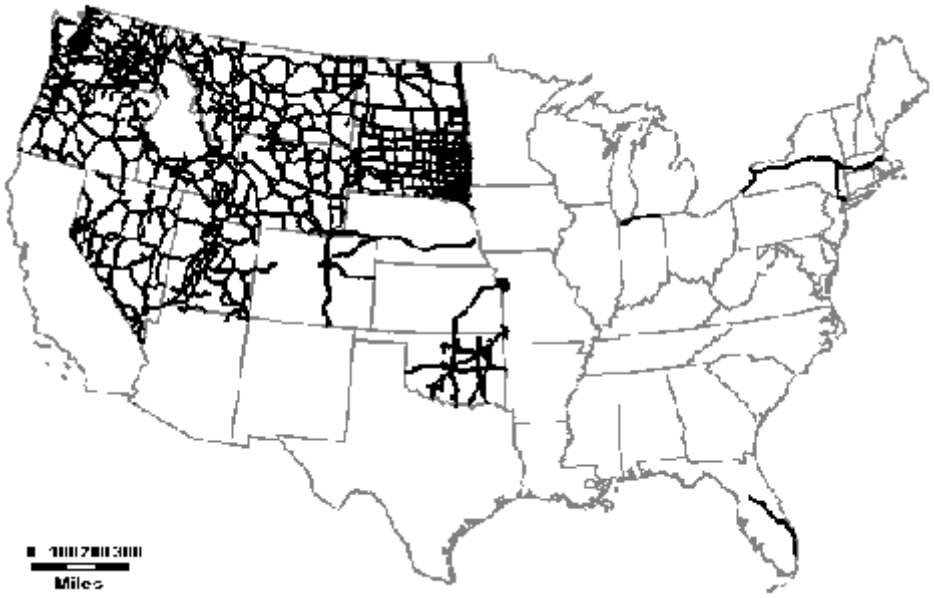
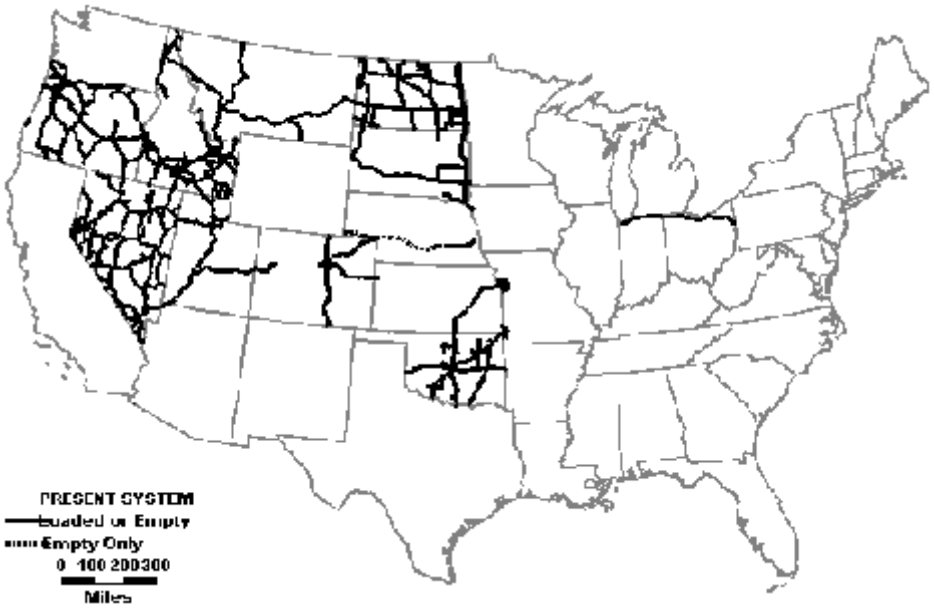


Figure III-6

Highways Available for RMDS

A triple-trailer combination consists of a tractor and typically three 28- to 28.5-foot trailers. Triple-trailer combinations are permitted to operate in 13 States under restrictive circumstances and on limited networks. Figure III-7 provides a map of the highways available for triple-trailer combinations.

Figure III-7
Highway Network Available for Triple-Trailers



COMMODITY CASE STUDIES

The use of trucking in the production and distribution of the four commodities: coal (in Kentucky), forest products (in the Northwest), farm products (in the upper-Midwest), and automobiles is discussed in this section.

COAL

Kentucky is a major producer of coal with more than three-quarters of its production used by electric utilities. Until the early 1950s, most coal was retrieved from underground coal mines, and rail was the principal mode for moving it. Underground mining and railroading complimented each other because

large quantities of coal were brought to the surface at relatively few locations, thereby, permitting the development of large loading facilities and concentrated rail lines.

Strip mining increased in the 1960s with increasing coal prices. Because this type of mining leads to the production of relatively small quantities of coal in many locations, usually at some distance from a rail line, it encouraged the use of trucks to haul coal, and the trucks used have increased in size and weight over the years.

Through the 1960s, 2- and 3-axle dump trucks were the standard means of haul. Some operators added lift axles to facilitate handling larger payloads. Because of the relatively low density of coal compared to stone and dirt normally handled in the dump trucks, coal truckers added side boards of as much as 2 feet in height to their dump boxes to permit handling larger payloads. This practice raised the center of mass of loads, leading to increasing problems with vehicle stability. Longer and heavier straight frame trucks continued to dominate the coal haul until into the late 1970s. By this time, to help accommodate the heavy loads being handled, many operators were inflating their tires to pressures as high as 150 to 200 psi -- as much as double the inflation pressures of many trucking operations, and a harmful practice for pavements.

Five-axle tractor-semitrailers were introduced in the late 1970s. This equipment generally used 20-foot boxes with 12- to 16-inch side boards. By the late 1980s, these units were being replaced with 6-axle tractor-semitrailers using a tridem axle semitrailer with 28-foot boxes. These longer trailers allow the loads to be placed over a longer distance with a lower center of gravity and enhanced stability. Air-lift axles started to be used in the tridem groups, first on the lead axle in the group, and most recently on both the lead and rear axle in the tridem. Tridem-axle semitrailer units are allowed to operate at GVWs up to 120,000 pounds on selected highways designated as the "Extended Weight System (EWS)."

Surveys at coal sites throughout Kentucky in 1988 and 1992 demonstrate that: (1) tractor-semitrailers dominate coal haul in the State; (2) 5-axle tractor-semitrailers are being replaced by 6-axle units; (3) the use of both 3- and 4-axle straight trucks is declining. Coal haulers have indicated that their vehicles have to be replaced about every 7 years. In 1992-1993, Kentucky issued EWS decals for 3,471 units.

FOREST PRODUCTS

The high concentration of natural forest production in the Pacific Northwest has generated an array of forest product industries involved in the harvesting, manufacturing and distribution of wood products. The harvested timber is used for: lumber, plywood, poles, shingles, paper, and raw logs for export. Lumber and plywood production dominate.

The growth and success of these industries has been promoted by an efficient transportation network comprised of truck, rail, and barge transport. However, trucks are the prime mode used for transporting timber from the harvest area, due to their flexibility and reliability in accessing remote forest areas. Typical maximum haul lengths are about 100 miles.

Sawmill products, mostly in the form of lumber, from the Pacific Northwest are distributed to all regions of the United States and exported abroad. However, the primary destinations (one-half to two-thirds) for sawmill products in Washington, Idaho and Oregon are in the West. About one-third of Montana products are shipped to the Midwest and another roughly one-third

to western markets. Ten to 15 percent of Washington/Oregon production is exported, while only a small proportion of Montana/Idaho production is exported.

There is substantial modal competition for the movement of sawmill products (mostly lumber). Trucking dominates in Washington and Oregon, accounting for nearly 60 percent of sawmill product moves. On average, rail handles about one-third of the product in these two States, and water handles about 10 percent. Water movements are typically export-bound. For Idaho, rail and truck share equally in the handling of sawmill products. For Montana, rail handles 60 percent and trucks handle 40 percent.

There is also substantial modal competition for moving of plywood. Plywood from the western region (west of the Cascade mountains) is handled equally by truck and rail. About two-thirds of plywood originating in the inland region (principally Eastern Washington and Oregon, Northern Idaho, and Western Montana) is handled by rail. Less than 1 percent of the plywood is moved by water, reflecting the small percentage of plywood that is exported.

Log production for export is concentrated in Washington at 73 log export sites and Oregon at 13 sites. Practically all movement of logs destined for export is by truck to either an ocean port for ship loading, or to the Snake or Columbia Rivers for barge transport to ocean ports. Generally, logs for export from Eastern Washington move down river, whereas the majority of log export movements originating west of the Cascades are done by truck.

Markets and movements of sawmill products in the Pacific Northwest involve either comparatively short hauls dominated by truck, or comparatively long hauls dominated by rail. Only about 10 to 20 percent of the movements operate over distances which could be considered competitive between truck and rail.

FARM PRODUCTS

Before the 1980s, the Midwest agricultural economy was primarily based on production of raw agricultural goods with some food processing. Transportation needs centered on the efficient movement of raw agricultural products. Except for short moves from farms to railheads, grain was primarily moved by rail to processing facilities across the country and to barge facilities for export. Meat was primarily moved by truck as either live animals to slaughter facilities or hanging carcasses to retailers throughout the country.

In the last 20 years, changes in farm production, transportation, and other technologies have combined to alter the Midwest agricultural economy from primarily a raw agricultural goods economy to include a large processed grain and meat sector. Production of farm products has increased as farms have become more efficient. At the same time the agricultural and food industries have diversified; instead of shipping farm products from the Midwest for processing, today more of the processing is done in the region close to the source of raw materials. Examples of value-added products that have emerged as a mainstay of the Midwest agricultural economy are: ethanol, cooking oils from both corn and soybeans, animal feeds, cereals, and corn sweeteners, and processed meat products. This has resulted in transportation

requirements shifting from the movement of raw farm products out of the region to the movement of farm products locally and the movement of processed food and grain milling products to regional markets or to more distant domestic and international markets.

There is a high level of integration of the agribusiness economies of the States in the Midwest. Much of the associated traffic moves within and among the Midwestern States. State boundaries are rather transparent to the agribusinesses. Recent surveys show that 70 percent of Iowa's agribusiness truck traffic is involved in movements within Iowa and between it and neighboring States.

Grain

The transportation of raw and bulk grain products is dominated by the need for efficient movement of large amounts of dense corn and soybean products. These movements are primarily served by rail. However, with grain processing moving closer to the location of raw production, some of the localized transportation needs of raw grain products are handled by trucks. These truck movements primarily involve short hauls of grain from farms to railheads, and the trucking of dry bulk products such as flour and sugar to food processors not served by rail.

The transportation of processed grain products is served primarily by truck. High-cube, low weight products like cereals do not require the large quantity, high-weight service capability provided by rail. In addition, these products are most often destined for retailers not easily served by rail. Other processed grain products such as baked goods have a relatively short shelf-life and may be somewhat fragile, thus requiring the quick, high-level service provided by truck to maintain product quality.

Widespread acceptance of 53-foot long, 102-inch wide semitrailers has allowed shippers of low density boxed breakfast cereal to increase their transportation efficiency (a 25 percent payload advantage over the 45-foot, 96-inch semitrailers of the early 1980s). This has encouraged cereal producers to locate their manufacturing facilities in smaller Midwestern communities close to raw material sources. For example, General Mills, Quaker Oats, Cargill Inc., and Archer Daniels Midland all have major grain milling facilities located in the Cedar Rapids, Iowa area.

The development of sealed pneumatic trailers has provided for greater efficiency in the transportation of bulk flour and sugar used in other value-added products such as baked goods, and bulk feed ingredients such as soybean meal and corn gluten. The aluminum construction of these trailers allows for more cargo capacity due to reduced tare weight of the trailer. These trailers have provided two types of efficiencies: (1) a reduction in manufacturing and manpower requirements for the packaging of the commodity because the product is shipped in bulk rather than bag, and (2) an increase in payload capacity through elimination of packaging materials and the use of lighter materials. Through a combination of lighter materials and using an extended-bridge mounting of rear tandem axles to lengthen the interior bridge dimension, pneumatic trailers carry payloads of 52,000 pounds (a 13 percent payload advantage over van trailers

handling packaged goods). Bagged shipments of these processed grain products are generally limited to 46,000-pound payloads.

Refrigerated trailers have experienced increases in productivity as a result of decreased tare weights. Because of the increased use of aluminum and composite components in trailer body construction and light, more fuel efficient refrigeration units that utilize smaller fuel tanks, today's 48-foot refrigerated trailers commonly have tare weight of 15,000 pounds or less (including the refrigeration unit) versus approximately 17,000 pounds for older trailers. Using these light trailers and properly specified tractors, carriers can routinely handle 46,000-pound payloads (a 2,000-pound increase over the common payloads available in the early 1980s). Fifty-three-foot trailers are not used because the cargo capacity of the vehicle is limited by maximum gross weight requirements rather than by a lack of volumetric capacity.

Livestock and Processed Meat

The most significant changes in the beef and pork industries over the past two decades are: (1) a shift in pork production from smaller, independent producers to large corporate hog finishing facilities and contracted hog finishing for meat packers; (2) relocation of meat processing facilities to the Midwest to be nearer beef and pork supplies; (3) large increases in meat exports to eastern markets due to improvements in refrigeration and transportation. These shifts have impacted the grain market in the Midwest with areas near large hog finishing facilities in the heart of high corn production territory actually importing corn to meet the demand for feed. Improvements in sanitation, meat processing, and packaging have changed the product being shipped longer distances from hanging carcasses to meat packaged for retail.

The transportation of livestock and processed meat products is served almost exclusively by trucks. Transport of livestock cannot be accommodated by the longer service intervals and unsupervised (no driver) nature of rail and intermodal container transportation. Market demands for high-quality meats require the fast, high-service available through truck transportation to ensure livestock arrives for processing in the best condition possible. Similarly, processed meats require high-level service (short delivery intervals and monitoring of refrigerated temperatures) that is not readily available through rail car service. A very small portion of processed meat freight is transported via intermodal container.

AUTOMOBILE INDUSTRY

Much of the in-bound transportation of auto parts and materials to assembly plants has been out-sourced to for-hire carriers. Also, there is a growing dependence on third party logistics providers, just-in-time delivery systems, and information technology. Other factors include containerization, intermodal moves, and international sources. Intermodal is a small but growing industry-wide trend that may be more pronounced in the auto parts sector of the trucking industry due to the international character of automobile production.

The sector of the trucking industry that moves the finished product from the assembly plants (an $1.8 billion per year business with approximately 13,000 power units and trailers) is significantly

different from the sector of the trucking industry involved in inbound transport. The number of outbound carriers used by each of the Big Three is small compared to the number of inbound carriers. Information technology is being deployed slowly by the outbound carriers, and the outbound carriers typically use trailers that have little use outside of auto hauling. Lastly, it is widely, but incorrectly, assumed that auto transporters cube out. Cars are getting heavier, and as a result, auto transporters are weighing out more and more.

CROSS-BORDER TRUCKING

Eleven of the 77 highway border crossings between Canada and the United States are Interstate highways. Four of the 38 highway crossings between Mexico and the U.S. Southwest are Interstate highways. Nine are on other NHS routes, and 25 are on other highways. The volume of truck traffic from Canada into the United States is twice as high as truck traffic from Mexico. In 1995, an average of 14,008 trucks entered the United States every day from Canada compared with 7,943 trucks per day from Mexico. Between 1991 and 1995, truck traffic from Canada grew by 9 percent per year and traffic from Mexico grew 11 percent per year.

WEIGHT LIMITS

Weight limits governing trucking operations across the two borders are very different. In crossing to Canada, all but 1 crossing for NHS highways have a GVW limit of more than 99,000 pounds; 9 of the 11 Interstate crossings have GVW limits of more than 105,000 pounds. In crossing to Mexico, all four Interstate crossings are limited to a GVW of 80,000 pounds, and six of nine other crossings on the NHS have a GVW of 84,000 pounds (with a permit from Texas).

TRUCK CHARACTERISTICS

The majority of trucking across the Canadian border is conducted with 5-axle tractor-semitrailer combinations, although a few single-unit trucks are used. Commonly used tractor-semitrailer combinations in the cross-border operations on the Canadian border include: (1) 7- and 8-axle combinations moving containers between British Columbia and Washington; (2) 7- and 8-axle A-train and B-train doubles, RMD, and triple-trailer combinations between the Western provinces and Northern Plains States; and (4) various heavy multiaxle combinations operating under Michigan and Ontario bridge formulas.

Differing TS&W limits between Canada and the United States result in unique situations. For example, an 8-axle tractor-semitrailer crossing into British Columbia from Washington converts to a 6-axle by lifting axles on the tractor and semitrailer, which is required; a wide variety of combinations have as many as 11-axles for operations between Michigan and Ontario.

A large portion of truck traffic between Mexico and the United States is dominated by the 2- and 3-axle single-unit truck and tractor-semitrailer combinations limited to 80,000 pounds. Very few double-trailer combinations are used.

DOMESTIC AND INTERNATIONAL CONTAINER TRANSPORT

Several new types of containers came into usage in the 1980s including refrigerated, ventilated, bulk cargo, intermediate bulk, and other specialized containers. It is anticipated that the search for improved productivity through increasing the size and capacity of containers, container equipment, and container facilities will effect truck movements. Two-thirds of the container loads handled in 1992 were international. The 1.2 million domestic loads were transported equally in reloaded marine containers and domestic containers.

Very few ports are capable of directly transferring maritime containers to the rail mode, and the railroads generally do not have direct access to container destinations. Consequently, as containerized freight transportation has grown rapidly in recent years, it has resulted in an increased number of maritime shipping containers traveling on the highways. These containers may be loaded at weights that cause trucks to exceed Federal, State, or local vehicle weight limits.

The increasing size and capacity of marine containers may add to problems of overweight transport on U.S. highways. The impact may differ by State. In California most container movements are less than 50 miles, but on the East Coast most movements are considerably longer. Thus, East Coast movements are more likely to be impacted by non-uniform State TS&W regulations, while movements in California are not.

Standard dimensions for international marine containers are: lengths of 20 and 40 feet; width of 8 feet; and heights of 8, 9 and 9.5 feet. Container lengths of 24 and 45 feet are rarely used for international transport, 24-foot containers are being phased out, and 45-foot containers are used only on limited trade routes. Domestic containers can be 102 inches wide, but international marine containers are limited to a width of 96 inches.

The dimensions of standard dry domestic containers in the United States are lengths of 45 feet, 48 feet, and 53 feet, width of 8.5 feet; and height of 9.5 feet. The 28-foot container is also common in the United States. These dimensions have been developed to take full advantage of the opportunities available from vehicle size regulations.

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